PFC FrontEnd™
Power Factor Corrected AC-DC FrontEnd

October 2013

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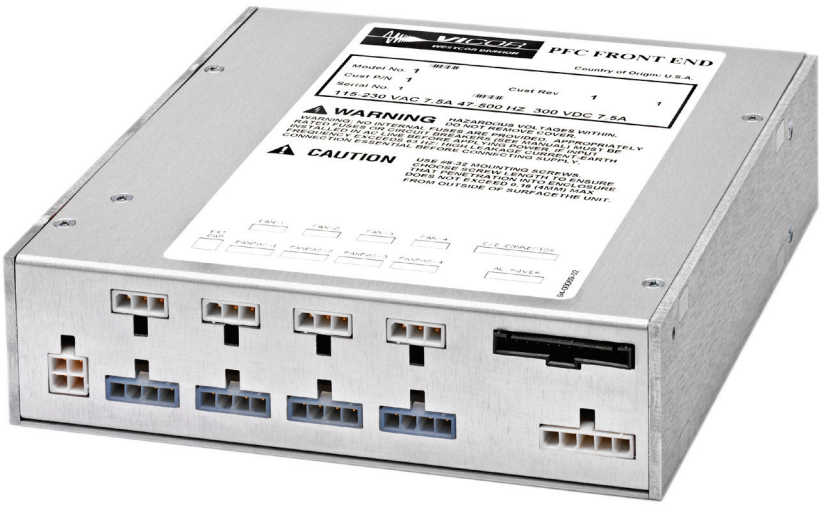


Overview

The PFC FrontEnd is an extremely low profile, 1 RU enclosed chassis-mount high Vout AC FrontEnd that may be used with any Vicor 300 V VI-200/VI-J00 brick, HV BCM converter, or 375 V Maxi, Mini, Micro modules and VIPAC Arrays (see page 13 for connection to module and VIPAC Array drawings) to create a complete, high-density AC-DC power supply. It can be ordered with output voltage set at 360, 375 or 384 VDC and can provide up to four nonisolated outputs (additional using "Y" adaptors). Accepting universal input voltages of 85 to 264 Vac, and 100 to 380 Vdc, the PFC FrontEnd can deliver up to 2,200 W in a package size of 1.72" H (43,6 mm) x 6.4" W (162,6 mm) x 7" L(177,8 mm).

Standard Features

- Power Factor Correction: 0.99 at 115 Vac; 0.95 at 230 Vac
- Universal input: 85-264 Vac, 47-800 Hz, or 100-380 Vdc
- Power output: 1,100 W at 115 Vac; 2,200 W at 230 Vac
- Output voltage: 360 VDC, 375 VDC or 384 VDC (± 3%) non-isolated
- Four connectors to the common non-isolated output bus
- Fan cooled (variable fan speed cooled)
- Rugged: Meets Mil-Std-810E, category 10, Minimum integrity test for Vibration
- Full power to 45°C; half power at 65°C
- Conducted EMI: EN55022, Class A
- Harmonic distortion complies with EN61000-3-2
- AC Power OK status signal
- Size: 1.72" H (43,6 mm) x 6.4" W (162,6 mm) x 7" L (177,8 mm)
- RoHS compliant
- Temperature controlled / Auto shutdown
- Safety agency approvals: CE Marking, cTÜVus

Optional Features

- DIN rail mounting (#19-130060) - see page 2
- Connector kit available (#19-130059)
- VIPAC Array adaptor (#19-130064)

Part Numbering

PFC FrontEnd	**FEXXX where XXX = 360, 375, or 384** dependent on output voltage desired

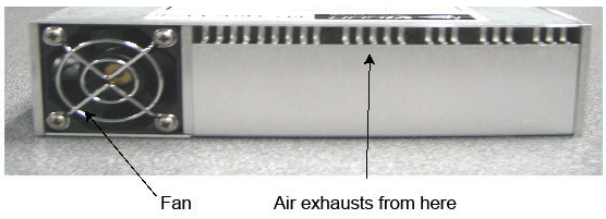
Mechanical Considerations

The PFC FrontEnd can be mounted on one of three surfaces using standard 8-32 (4 mm) size screws. Maximum allowable torque is 4.4 in. lbs. and the maximum penetration is 0.16 in. (4 mm).

When selecting a mounting location and orientation, the unit should be positioned so air flow is not restricted. Maintain a 2" (5,1 cm) minimum clearance at both ends of the PFC FrontEnd, and route all cables so airflow is not obstructed. The power supply draws air in at the fan side and exhausts air out the same side. If airflow ducting is used, avoid sharp turns that could create back pressure. The fans move approximately 20 CFM of air.

Avoid excessive bending of output power cables after they are connected to the output terminals. For high-current outputs, use cable ties to support heavy cables and minimize mechanical stress on connectors. Be careful not to short-out to neighboring outputs. The maximum torque recommended on output nuts is 10 in. lbs.

Avoid applications in which the unit is exposed to excessive shock or vibration levels. In such applications, a shock absorbing mount design is required.



PFC FrontEnd Do's and Don'ts

- Always turn the power supply off, before disconnecting input or output wires.
- Do not restrict airflow to the unit. The cooling fan draws air into the unit and forces it out at the output power terminals.
- Run the output (+/–) power cables next to each other to minimize inductance.
- Do not repair or modify the power supply in any manner.
  Doing so will void the warranty. Contact Factory.
- Insert proper fault protection at power supply input terminals (i.e., a fuse).
- Use proper size wires to avoid overheating and excessive voltage drop.

Technical Description

The PFC FrontEnd consists of an off-line single phase, power-factor-corrected front end, EMI filter, cooling fan, customer interface and associated housekeeping circuits.

Input AC mains voltage is applied to a terminal block. The input current is passed through an EMI filter designed to meet conducted noise limit "A" specifications in FCC Part 15 and EN55022, Class A.

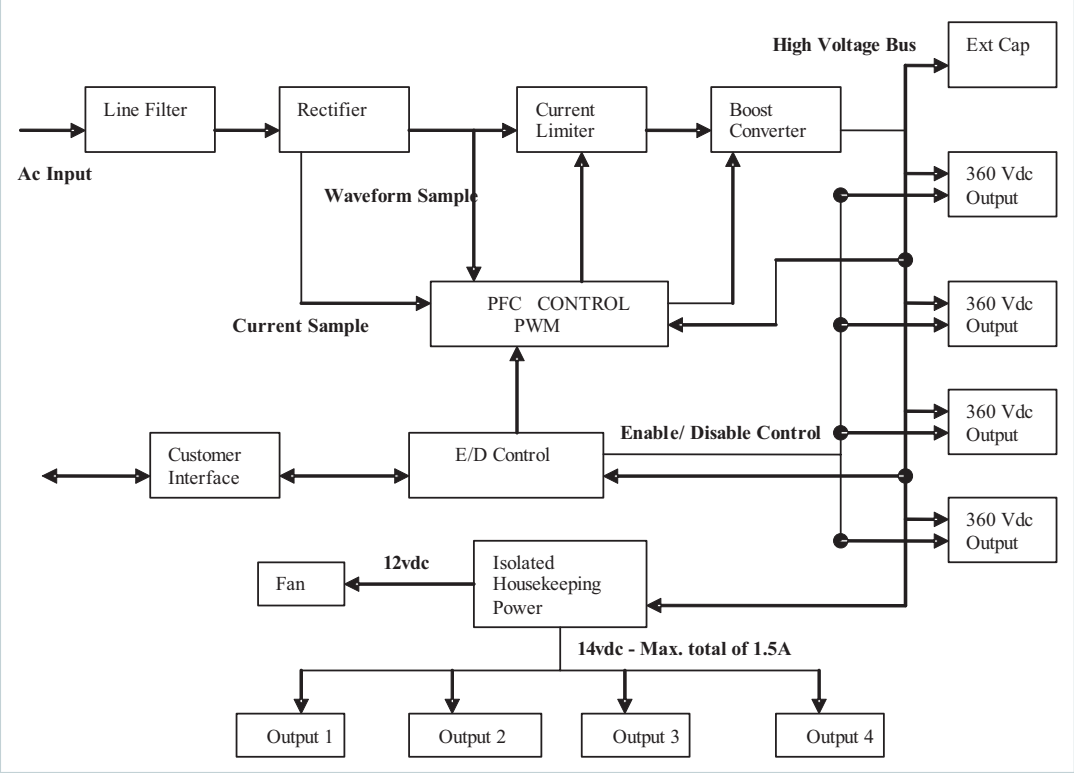
At start-up, inrush current is limited by a PTC thermistor. The PTC is shunted out shortly after initial power-up by a DC bus voltage sense circuit driving a relay. After rectification, the input voltage is put through a boost converter that keeps the AC input current sinusoidal and synchronized with the input AC voltage (in compliance with EN61000-3-2). The boost converter delivers a regulated input to the hold-up capacitors and a high voltage backplane.

At initial power-up, the PFC FrontEnd output control lines are disabled to limit the inrush current and to allow the DC bus potential to settle out to the correct operating level. A low-power flyback converter operating with PWM current-mode control converts the high voltage DC bus into regulated low voltage to power the internal housekeeping circuits and DC cooling fan.

The internal housekeeping Vcc comes up within two seconds after the application of input power. Once the high voltage bus is within operating limits, the AC Power OK signal asserts to a TTL "1," indicating the input power is OK, and enables the power outputs. An auxiliary Vcc output of 5 Vdc sourcing up to 0.3 A is provided for peripheral use.

An output Enable/Disable function is provided by using an optocoupler to control the converters that are used in conjunction with the unit. If the Enable/Disable control pin is pulled low, the optocoupler turns on and disables the downstream module output. Please note that this does NOT disable the 384 V. The nominal delay associated for a converter output to come up when measured from release of the Enable/Disable pin is 5-10 ms. The General Shutdown function controls all outputs simultaneously and works

Figure 1.
PFC FrontEnd Architecture



PFC FrontEnd "Quick Install" Instructions (For Mechanical Drawing, see page 13)

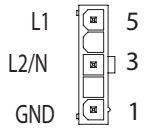
Mounting the PFC FrontEnd

- Mount the PFC FrontEnd on one of three sides.
- Use #8-32 or 4 mm mounting screws. Maximum penetration should not exceed 0.16" (4 mm).
- Maintain 2" (5,1 cm) clearance at both ends of power supply for airflow, mounting the PFC FrontEnd with DIN rails.
- The PFC FrontEnd can be mounted to a standard 35 mm DIN rail using optional mounting kit # 19-130060.
- DIN rail kit can be attached to the bottom or one side of the PFC FrontEnd.
- Use #4-40 mounting screws. Maximum penetration should not exceed 0.25".

Input Connections

Input Power MBJ6

MBJ6



HOUSING: MOLEX P/N: 39-01-4051
TERMINALS: MOLEX P/N: 44476-3112 (16 AWG)
CRIMP TOOL: MOLEX P/N: 11-01-0199

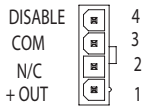
- AC power is applied to MBJ6 through a mating molex connector.
- Maximum torque is 5 in. lbs.
- Place a fuse or circuit breaker in the input line for safety requirements.
- Using Molex mating connector 39-01-4051with socket pin 44476-3112 (using 16 AWG) and crimp tool 11-01-0199.

Output Connections

Power Connections

Output Connectors (MB J1 -J4)

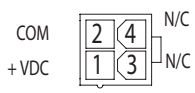
OUTPUTS I THRU 4



- Provide connection to the 384 V common output power bus.
- Provide individual connections to output module enable/disable lines. These are controlled by input lines E/D 1-4.
- See mechanical drawing for appropriate Molex crimp tool information. four mating connectors are provided with each supply.
- Minimum wire size 20 AWG.

HUB connector (MBJ5)

MBJ5
(EXTERNAL CAP)

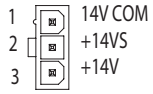


- In case increased hold-up time is needed, this provides a modular connection to an external hold-up box. A maximum of 1,640 uF can be added.
- Used Molex mating receptable 39-01-2040 (4 positions) with #39-00-0039 terminals.
- Attach 18-24 AWG stranded wire using Molex tool #11-01-0197.
- One mating connector is provided with each supply.

PFC FrontEnd "Quick Install" Instructions (Cont.)

OUTPUTS I THRU 4

E/D 14VDC



Auxiliary Power Connectors (CBJ1 - J4)

- Provides connection to a common 14 V auxiliary power output.
- Provides fan power when used in conjunction with output units.
- Can source a maximum of 1.5 Amps in total.
- Used Molex mating receptable 39-01-4030 (3 positions)/39-01-4040 (4 positions) with #39-00-0039 terminals.
- Attach 18-24 AWG stranded wire using Molex tool #11-01-0197.
- Four mating connectors are provided with each supply.
- 14 V output active @ AC ON (for use with fan).
- 14 VS output active @ 384 output on (for use with VIPAC Array only).

CBJ5

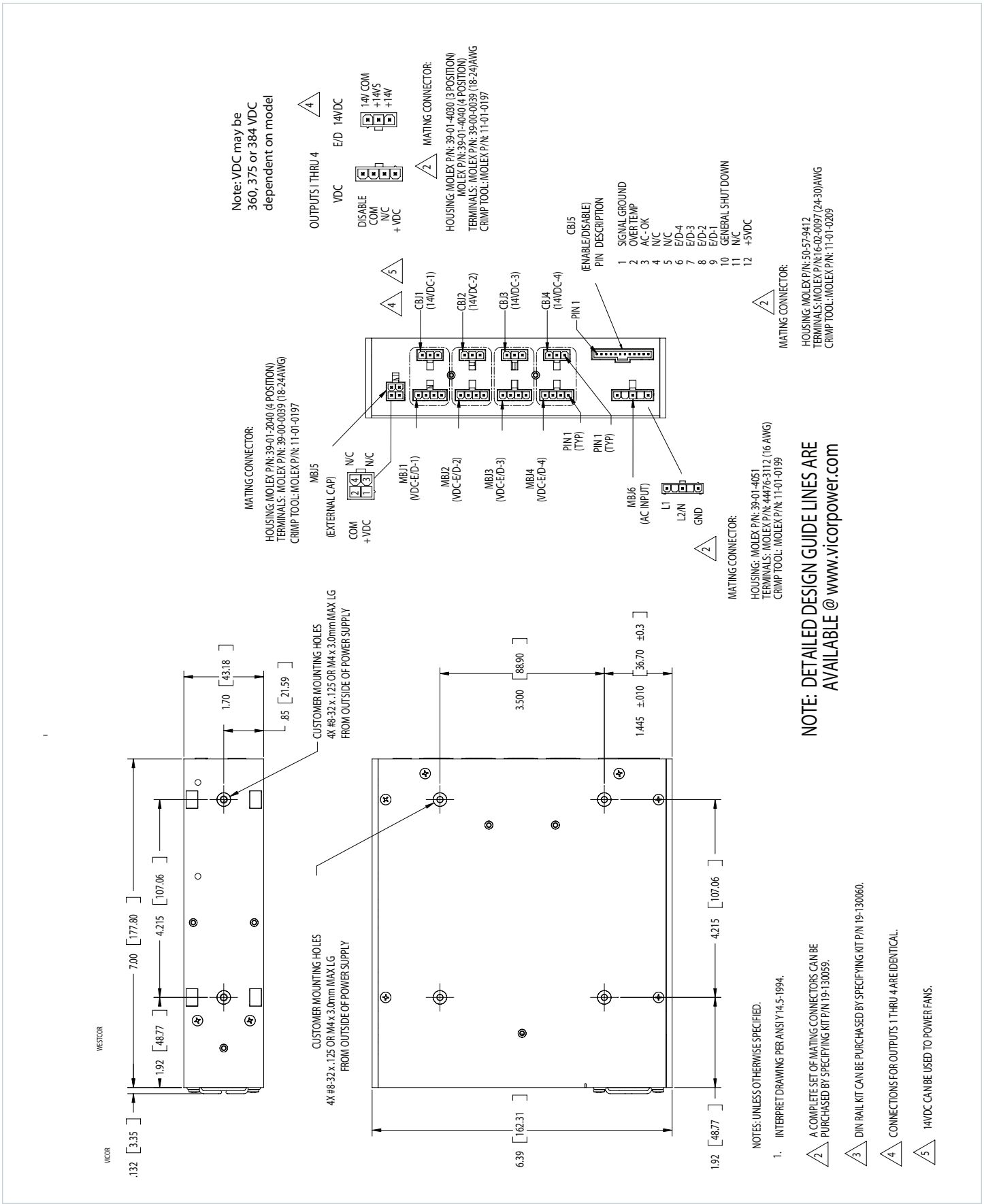
(ENABLE/DISABLE)

PIN	DESCRIPTION
1	SIGNAL GROUND
2	OVER TEMP
3	AC - OK
4	N/C
5	N/C
6	E/D-4
7	E/D-3
8	E/D-2
9	E/D-1
10	GENERAL SHUT DOWN
11	N/C
12	+5VDC

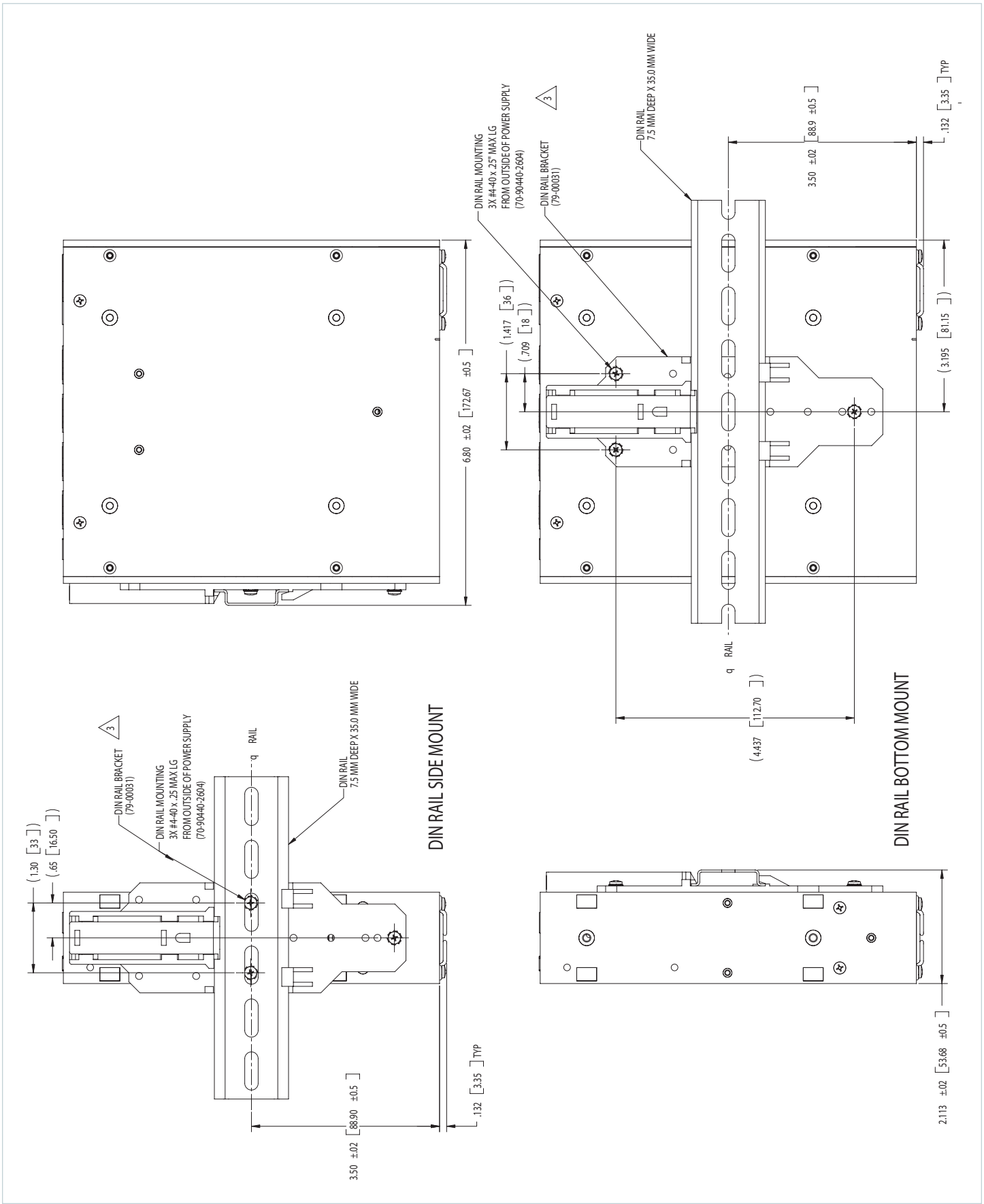
Interface Connections

- J5-1 to the Signal Ground.
- J5-2 provides over temperature status.
- J5-3 is A/C O.K.
- J5-9 are Enable/Disable for cards 1 -4 respectively.
- J5-10 is General Shutdown.
- J5-12 is +5 Vdc.
- Use mating receptable Molex 50-57-9412 with terminals Molex 16-02-0097.
- Attach terminals to 24-30 AWG stranded wire.

PFC FrontEnd Mechanical Drawings



Mounting the PFC FrontEnd within DIN Rail



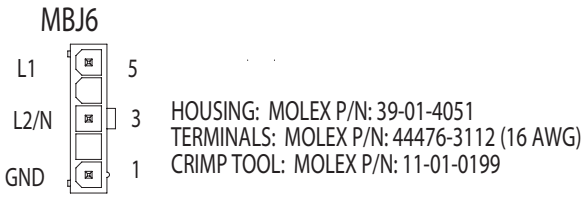
Interface Connections

Chassis Input Power Terminals (MBJ6)

Input AC power is applied through connector MBJ6 using Molex mating connector 39-01-4051. Use 16 AWG wire with socket pin 44476-3112 and crimp tool 11-01-0199.

A fault clearing device, such as a fuse or circuit breaker, with a maximum 12 A rating at the power supply input is required for safety agency compliance. It should be sized to handle the start-up inrush current of 2 A at 115 Vac and 5.5 A at 230 Vac.

Figure 2.
Input Power Terminals



Output Power Connections (MBJ1 - 4)

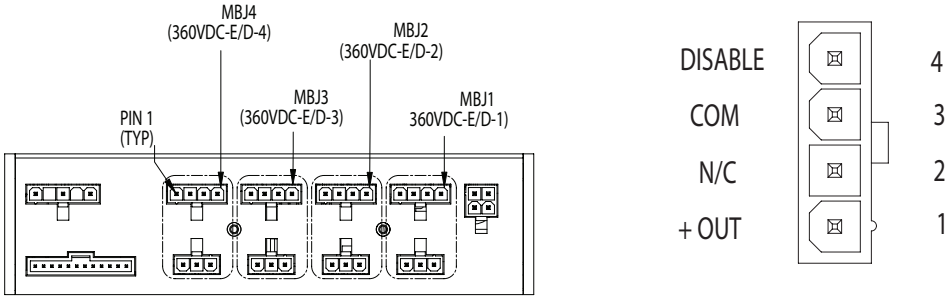
Outputs terminate in a Molex connector. These outputs are not isolated.

These four outputs all connect to the common 384 V output bus and provide easy modular connectivity. They also house four separate control lines that provide disable and enable for Vicor DC-DC converters connected to the PFC FrontEnd. Upon start-up, all 4 of these lines are held low to disable the external converters until the PFC FrontEnd comes up properly. After that, control of this function is handed over to the input lines E/D 1-4. Please note that any external load, whether a Vicor module or other, must be disabled during the startup phase.

Individual outputs may be connected to more than one module to form output arrays. Each control line can enable/disable up to three separate modules. Larger arrays may be possible through the use of external relays or transistor circuits. Please contact Applications Engineering for assistance in these cases.

In order to minimize parasitic cable inductance and reduce EMI, the output power cables should be routed in close proximity to one another, and large current loops should be avoided. To avoid excessive voltage drop, do not undersize power cables, especially for high current outputs. Excessive cable inductance coupled with large capacitive loading can introduce instability in switching power supplies. This problem can be avoided with proper system design. Consult Vicor's Applications Engineering for assistance with applications that use long cable lengths and excessive load capacitance.

Figure 3.
Output Power Connections



Interface Connections (Cont.)

Signal Ground (J1-3, J2-3, J3-3, J4-3)

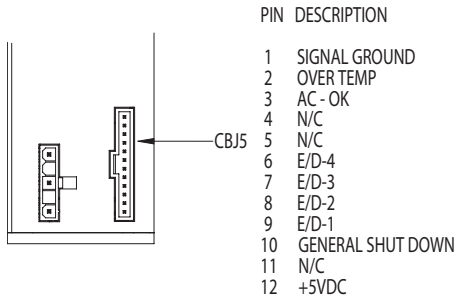
J1-J4 are for ED1-ED5 interface signal.

Over Temperature Protection (J5-2)

The PFC FrontEnd monitors the internal heat-sink temperature to provide several functions:

- Variable fan speed. Minimum fan speed occurs at 24 C and lower as measured on the heat sink. Maximum fan speed occurs at 70°C and above.
- Over-temperature shutdown. If the heat sink reaches 90°C +/- 5°C the Over-Temp indicator signal (pin 2 on CBJ5), which is normally low, will assert high to indicate an over-temperature condition. Also, all individual module control lines on MBJ1-4 will go low to disable the output loads. The supply will re-enable when the heat sink temperature drops below approximately 83°C and the over-temperature indicator will reset to a low condition.

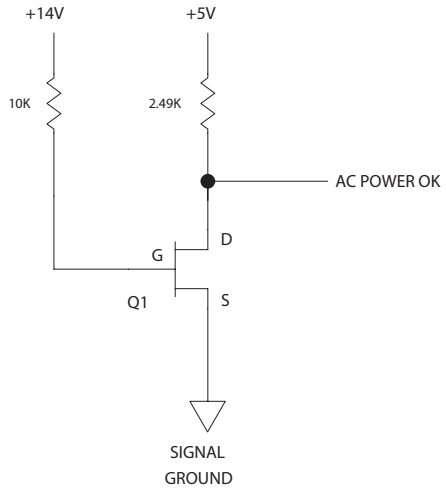
Figure 4.
Over temperature protection



AC OK (J5-3)

AC OK is an active high TTL compatible signal and provides a status indication of the AC input power. It is on pin J6 and is capable of sinking 16 mA minimum. This signal switches to a TTL "1" when the high voltage bus exceeds low-line condition during turn-on. Upon loss of input power, the bus voltage will drop, causing the AC OK signal to go low. A minimum of 3 ms hold-up time is provided for a 1,200 W load following the loss of the AC OK signal.

Figure 5.
AC OK



Interface Connections (Cont.)

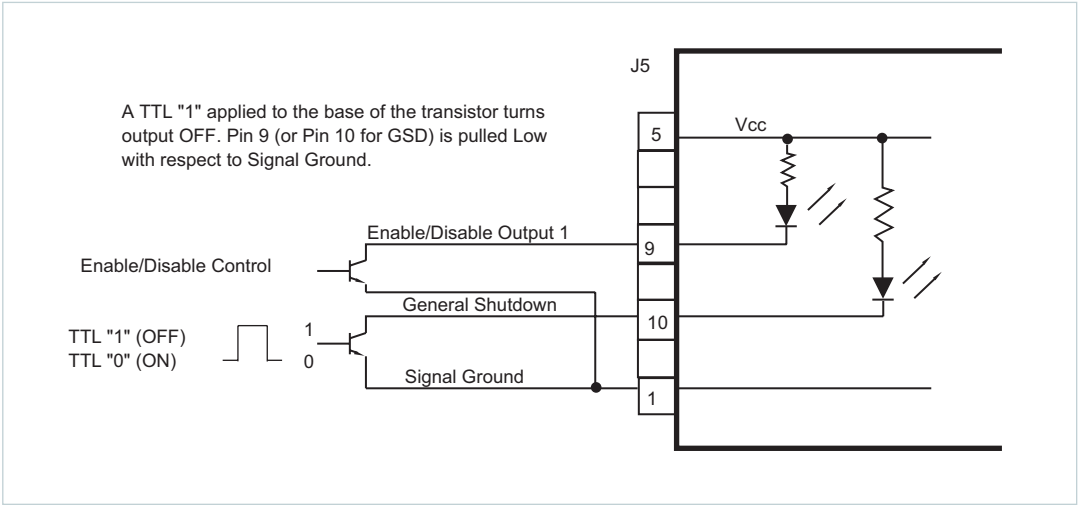
Enable/Disable (J5-6 to J5-9)

The Enable/Disable control pins allow connected converter outputs to be sequenced either on or off. The Enable/Disable pins should be pulled low to less than 1 V with respect to Signal Ground to disable the outputs. They will source 10 mA maximum. These pins should be open circuited or allowed to exceed 4.5 V when enabled. Do not apply more than 5 V to these inputs.

General Shutdown/GSD (J5-10)

The GSD control pin on J5-10 allows simultaneous shutdown of all attached converter outputs. This pin must be pulled down to less than 0.7 V, and will source 4 mA maximum to shut down all outputs. The GSD pin should be open circuited or allowed to exceed 4.5 V when not in use, or when the outputs are to be enabled. Do not apply more than 5 V to this input at any time. Normal open circuit voltage is 1.5 to 3 V with respect to Signal Ground.

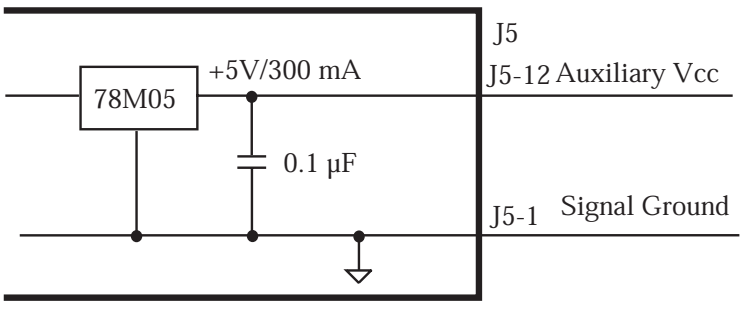
Figure 6.
Enable/Disable and General Shutdown



Auxiliary Vcc +5 Vdc (J5-12)

The Vcc on J5-12 is an auxiliary 5 V regulated power source. It is +5 Vdc +/-5% with respect to Signal Ground and can supply 300 mA maximum. It is short-circuit-proof, but if shorted, all outputs will shut down through the Enable/Disable circuitry.

Figure 7.
Auxiliary Vcc

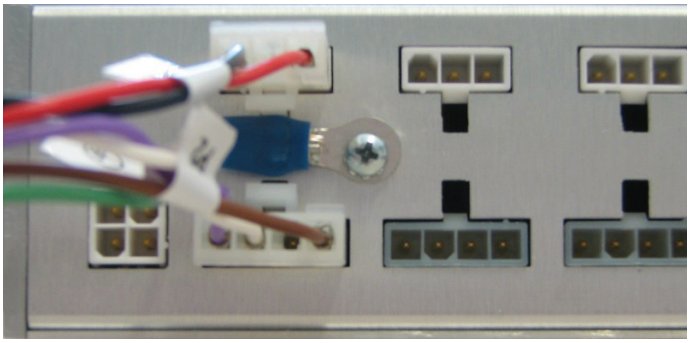


Interface Connections (Cont.)

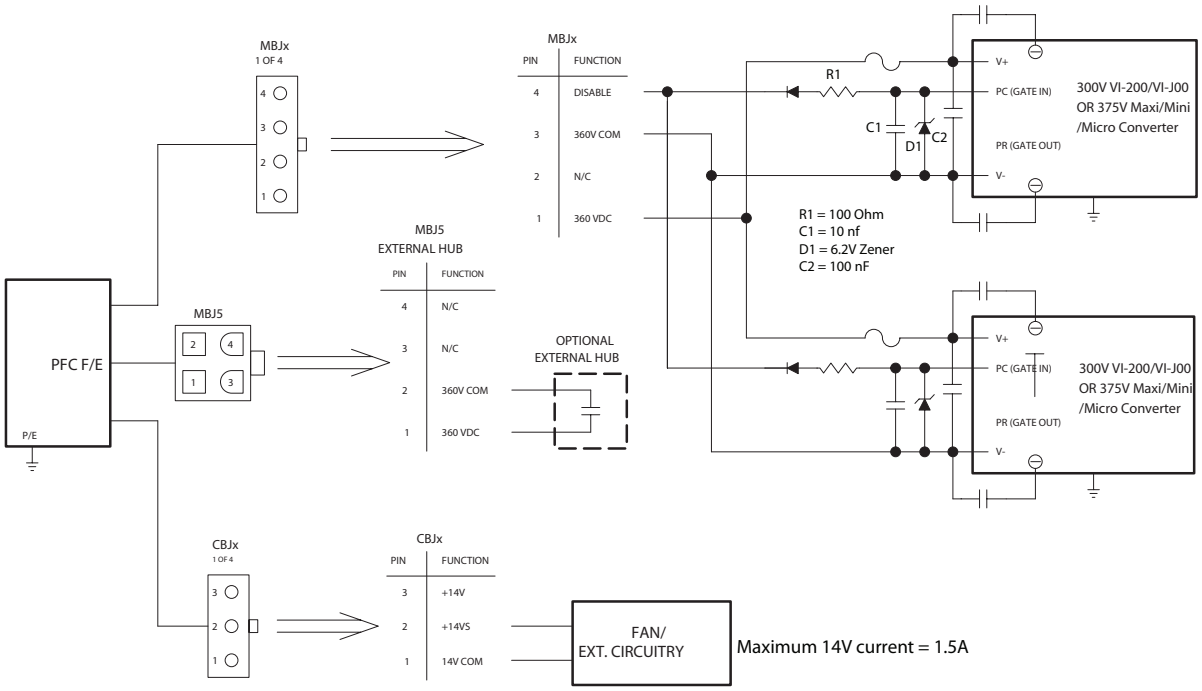
Optional ViPAC Array Adaptor (refer to connection drawing on the following page)

The VIPAC Array adaptor provides plug and play compatibility between the PFC FrontEnd and any 375 V VIPAC Array while continuing to meet safety and emissions specifications. Up to four adaptors and arrays may be used with one PFC FrontEnd, enabling as many as 16 separate isolated DC outputs from the system.

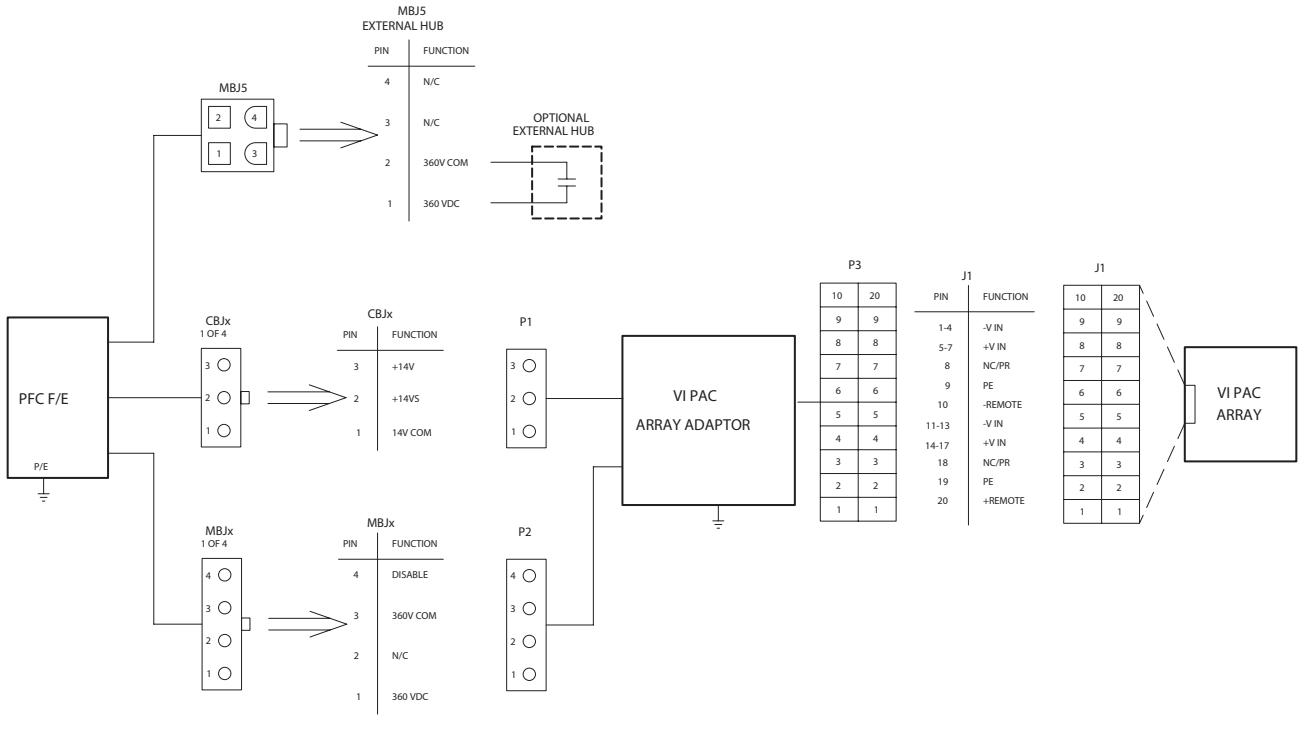
To ensure proper grounding when connecting a VIPAC Array to the PFC FrontEnd, please use the grounding wire and lug bundled with the P1 and P2 connectors of the VIPAC Array adaptor. Ground connection holes are located between the output and auxiliary power connectors of the PFC FrontEnd. Use a 4-40 screw with a maximum protrusion of 0.125″. Ground will be provided to the VIPAC Array adaptor through molex connector P3.



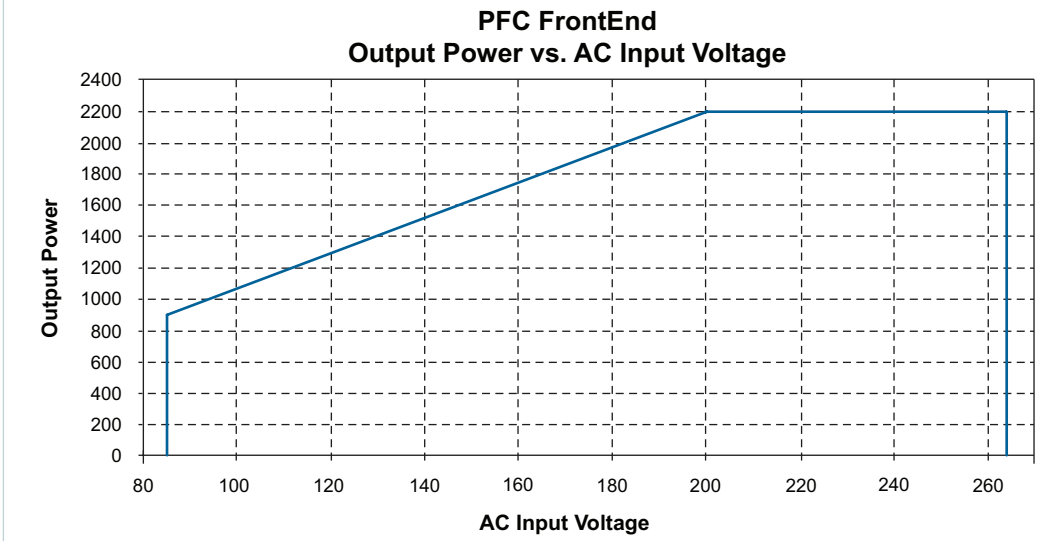
PFC FrontEnd Connection to Vicor Modules

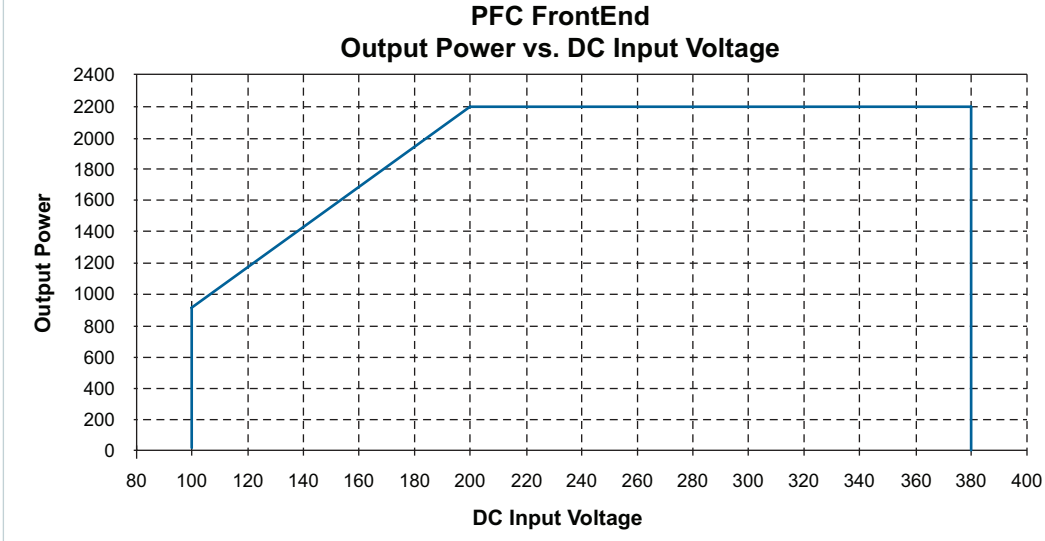


PFC FrontEnd Connection to VIPAC Array



PFC FrontEnd Output Power vs. Input Voltage





Specifications (Typical at 25°C, nominal line and 75% load, unless otherwise specified)

General Characterisitcs	
Number of Outputs (unisolated)	Up to 4. Additional using "Y" adaptors"
Efficiency	> 90% minimum
Safety Approvals	cTÜVus, CE Marking
Vibration	Meets MIL-STD-810E, Category 10, Minimum Integrity test
Output voltage (model dependent)	360, 375 or 384 VDC (± 3%) non-isolated
Maximum Output Power+	1,100 W @ 115 Vac; (900 W @ 85-100 Vac) 2,200 W @ 230 Vac (1,900 @ 180 - 200 Vac)
Start-up time	Nominal 800 mSec; Worst case 6Sec. after extended soak @ 65°C
Note: Not to exceed an input current of 12 A.	
Input Characterisitcs	
Input	85-264 Vac, 47-800 Hz 100-380 Vdc
Inrush Current	2 A pk @ 115 Vac; 3.5 A pk @ 230 Vac
Conducted EMI	EN55022, Class A
Power Factor	0.99 @ 115 Vac: 0.95 @ 230 Vac
Voltage Fluctuations and Flicker	EN61000-3-3
ESD Susceptibility	EN61000-4-2, Level 3, Performance Criteria A
RF Radiated Immunity, 10v/m	EN61000-4-3, Performance Criteria A
Transient Burst Immunity	EN61000-4-4, Level 3, Performance Criteria A
Surge Immunity	EN61000-4-5 Installation Class 3, Performance Criteria A
RF Conducted Immunity	EN61000-4-6, limit Class 3 Performance Criteria A
Voltage Dips and Interrupts	EN61000-4-11
Dielectric Withstand	Primary to Chassis GND = 2,121 Vdc
Environmental Characteristics	
Storage Temperature	-40°C to +85°C
Operating Temperature	Full Power -20 to +45°C Half Power -20 to +65°C
Altitude	Derate 2.6% total output power for each 1,000 ft to a maximum operating altitude of 15,000 ft. Non-operating storage maximum altitude is 40K. 75% maximum load
Humidity	0 to 95% non condensing
Product Weight	5.0 lbs. (2,3 kg)
Dimensions	1.72" H (43,6 mm) x 6.4" W (162,6 mm) x 7" L (177,8 mm)
Warranty*	2 years limited warranty. See vicorpower.com for complete warranty statement.

* Opening, repairing or modifying the unit will void the warranty. If you have any problem with the power supply, please contact Customer Service at 1-800-735-6200. If the unit needs to be returned for inspection/analysis, an RMA number will be issued.
All units must have a RMA number prior to return.

For Vicor Global Office Locations, please go to: http://www.vicorpower.com/contact-us
or call 800-735-6200.

For more information about this or other Vicor products, or for assistance with component-based power system design, contact the Vicor office nearest you. Vicor's comprehensive line of power solutions includes modular, high-density DC-DC converters and accessory components, configurable power supplies, and custom power systems. Westcor, a division of Vicor, designs and builds, configurable power supplies incorporating Vicor's high density DC-DC converters and accessory components.

Westcor's product line includes:

LOPAC FAMILY:
- PFC MicroS
- PFC Micro
- PFC Mini

MEGAPAC FAMILY:
- PFC MegaPAC
- 4kW MegaPAC
- 4kW MegaPAC-EL (Low Noise)
- PFC MegaPAC (High Power)
- PFC MegaPAC (Low Noise/High Power)
- PFC MegaPAC-EL (Low Noise)
- Mini MegaPAC
- Autoranging MegaPAC
- ConverterPACs

OTHERS:
- FlatPAC-EN
- PFC FrontEnd
- MicroPAC
- Conduction Cooled MicroPAC

Rugged COTS versions (MI) are available for the PFC Micro, PFC MicroS, PFC Mini, and PFC MegaPAC.

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The Power Behind Performance